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Canada Centre for Mineral and Energy Technology

Centre canadien de la technologie des minéraux et de l'énergie

Coal Research Laboratories

Laboratoires de recherche sur le charbon

Canada

COAL INDUSTRY VIEWS ON COAL PREPARATION R&D NEEDS AND POTENTIAL FOR COOPERATIVE WORK

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COAL INDUSTRY VIEWS ON COAL PREPARATION R&D NEEDS AND POTENTIAL FOR COOPERATIVE WORK

by

M.W. Mikhail* and A. Romaniuk**

ABSTRACT

This report is a record of the response by coal companies in Canada to an initiative undertaken by CRL/CANMET, to determine their specific coal preparation research and development needs, and to assess their interest in collaborative research.

Information was collected by means of a questionnaire used during meetings, mostly at plant sites and mostly with plant superintendents. Included in the CRL/CANMET presentation were three specific cooperative research proposals covering on-line slurry ash monitors, column flotation, and performance evaluation.

Fifteen client organizations across Canada were contacted during the period June 16 to August 5, 1988. Prospects for collaborative research with most clients appear very good, especially on the topics:

- fine coal cleaning and treatment
- transportation
- process control
- performance evaluation

Contacts made will be maintained and the best prospects for collaborative research will be followed up with proposals for specific collaborative research projects with either consortia or individual client companies.

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PERCEPTIONS PAR L'INDUSTRIE DU CHARBON DES BESOINS EN R ET D ET DES POSSIBILITÉS DE TRAVAUX DE COLLABORATION EN MATIÈRE DE PRÉPARATION DU CHARBON

Le présent rapport est un relevé des réactions des sociétés charbonnières canadiennes à un projet entrepris par les LRC de CANMET pour déterminer les besoins en recherche et développement sur la préparation du charbon de ces mêmes sociétés et pour évaluer l'intérêt qu'elles portent aux travaux de collaboration.

Les données ont été recueillies au moyen d'un questionnaire présenté au cours de réunions tenues, dans la plupart des cas, dans les usines, avec les directeurs d'usine. Trois propositions de recherche de collaboration portant sur les appareils de surveillance en continu des cendres de schlamms, la flottation en colonne et l'évaluation du rendement ont été présentées par les LRC de CANMET.

Du 16 juin au 5 août 1988, 15 organismes clients à travers le Canada ont été rejoints. Les possibilités de recherche de collaboration avec la plupart des clients semblent très bonnes, en particulier dans les domaines suivants :

- nettoyage et traitement du charbon fin
- transport
- régulation des procédés
- évaluation du rendement

Les liens créés seront maintenus et les projet de recherche de collaboration les plus susceptibles d'être réalisés feront l'objet de propositions de recherche de collaboration particulières avec des consortiums ou des sociétés individuelles.

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INTRODUCTION

Over the past several years, the Canadian export coal industry has been faced with oversupplied markets and as a result coal prices have decreased significantly. To meet the challenge, the coal industry successfully implemented measures to reduce operating costs and improve productivity. In coal preparation, the task has been to optimize recovery with emphasis on quality control to meet the fierce competition in the export market. Downsizing of manpower as a cost-cutting measure has made the task of performing research and development to meet short-and long-term needs difficult, if not impossible.

Competition in the marketplace has likevise had an impact on coal research in Canada, where the Canada Centre for Mineral and Energy Technology (CANMET) is the major player. CANMET's nev research directions for coal, and other mineral and energy commodities, aim to improve technological performance as a means of improving Canada's international competitiveness, and also to make better use of R&D funds as a lever for increasing private sector expenditures on R&D. The Coal Subcommittee of the Minister's National Advisory Council to CANMET have endorsed these new directions with specific recommendations which will lead to a better definition of the real-life R&D problems of industry, more collaborative research and improved technology transfer. This report describes part of Coal Research Laboratories initiative in these directions.

As a first step in implementing the above goals, the authors were asked by the Director, Coal Research Laboratories, to get industry views on potential for interaction. The purpose was:

1. To determine specific research needs of coal companies during visits by CANMET/CRL to mine sites.

2. To describe to coal companies the research capabilities and special and unique facilities of CANMET/CRL.

3. To invite participation in task-shared and/or cost-shared research.

The visits took place during June 16 to August 5, 1988. A total of 15 companies were contacted (Appendix A), of which 13 were coal producers and two were power companies. This report summarizes industry's views on research priorities and evaluates feedback in relation to potential for cooperation. Also included are recommendations on hov to implement vhat is needed for continuing dialogue and closer interaction with industry.

APPROACH

The plan was to meet first line management personnel responsible for coal preparation in producing companies and also if applicable, to meet individuals who are responsible for R&D and/or business development.Two power corporations in Eastern Canada were also contacted because of their interest in burning upgraded coals. The companies were made avare of CRL's objectives and the confidentiality of their identities in relation to information provided.

A questionnaire (Appendix B) was used to collect information and to generate discussions vith companies' representatives. Each meeting lasted between one and three hours. During the discussions, three written proposals were introduced and explained to the company representative(s) for immediate reaction and a response at a later date. Each of the three proposals noted below included a statement defining the issue, the objective, vork methodology and a budget estimate:

- On-line slurry ash monitor for froth flotation control
- Evaluation of column flotation in optimizing recovery of coal flotation circuits
- Performance evaluation of Canadian vash plants.

Questionnaires prepared initially by the authors vere sent back to the companies to reviev and confirm or expand on earlier answers. The plan is to follov up on the promising prospects for cooperative vork in the immediate future.

EVALUATION OF FEEDBACK

COMMUNICATION AND INTERACTION

Most of the producing companies are familiar with CRL facilities. This knowledge is based on earlier visits or tours that usually provided general views of the facilities with little in depth understanding of their relevance to operational needs. This was especially evident in a statement from one plant superintendent for whom CRL had performed cost recovery work using the pilot plant facilities. He stated he had a much better understanding of the pilot plant's capabilities following exposure to the facility over a period of days. The majority indicated that a one-day workshop or seminar on special topics, followed by a detailed tour, would be beneficial in assessing the relevance of CRL's pilot plant to their operational needs.

Seminars on topics including process control, devatering, fines cleaning,.. etc. were discussed. The majority of companies felt that such seminars would be beneficial as a means of keeping up-to-date technically. Contacts with experts working in special fields and exposure to each others' operating experience was considered desirable. The majority believed that Devon was the ideal place for such seminars. Others suggested Calgary and Sydney. A wide range of frequencies were suggested (1 to 6 per year); however, the majority requested two seminars per year. A format similar to that used by the Coal Preparation Society of Canada* which was active up to 1982 was favoured by most. Regular visits by CRL staff to preparation plants (at least once a year) were also suggested by most as a means of maintaining ongoing interaction and exchange of information.

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* The Coal Preparation Society was active between 1976 and 1982, holding meetings in different places; the meetings included field visits and covered topics that were unique to certain operations. The society's members were industry coal preparation engineers, and researchers from universities and research organizations such as CANMET.

RESEARCH PRIORITIES

Table 1 shows R&D priorities divided between shorter term (less than 2 years) and longer term. Views presented in this report are mostly those of individuals directly involved in coal production and therefore reflect mostly existing operating problems, i.e. projects of short-term duration. The following are brief descriptions of existing problems and suggested R&D achievements needed to benefit the coal industry.

1. Fine Coal Cleaning and Treatment

Fines (-0.6mm) in run-of-mine coal represent 20 to 70 % by mass of the feed to the preparation plant. Generally the cost of fines preparation is three to five times that of treating coarser particles. Also the losses to tailings in the fines circuits are up to 10 times those in the coarse coal circuits. These facts indicate the importance of fines circuits to the overall efficiency of the preparation plant. As a result, fines treatment is the highest priority for most companies.

The two key areas that were pointed out for R&D work are the water-only cyclone and froth flotation, along with the devatering of the clean products. Problems vary from one plant to another, as they relate to the nature of the feed and the design of the plant. Some problems indicate the on-line need for a monitoring system to detect variations in the feed, so that adjustments in operating conditions can be made quickly. Some indicated the need for designing new spirals capable of low cutpoints, to achieve the required ash quality in clean coal. Several companies indicated interest in testing column flotation and exploring its application to cleaning their coals.

2. Transportation

Rail transportation costs represent 30 to 50% of the total cost of saleable coal. Reducing transportation costs is essential for the maintenance and expansion of coal sales to Ontario and export markets. Some companies indicated the need to investigate both the technical

feasibility and, more importantly, the economics of alternatives to rail transportation--namely the pipelining option. Several were concerned with dust problems during handling and transportation. Economic alternatives are needed to resolve the problem of handling and moving coal at a reasonable cost. It appears that freezing during transportation is of much less concern than dustiness. Transportation alternatives are considered to be a long-term R&D need, while problems of dustiness and freezing are seen as relatively short-term.

3. Process Control

Process control is recognized as a key to improving and optimizing recovery. Several respondents mentioned the model of the Australian coal industry in introducing automation into its plants. The basic tools for automation are on-line measuring instruments. These include on-line ash, moisture, sulphur and FSI instruments along with existing per cent solids, mass, flow rates and level controls. The objective of automation is process optimization. Several companies recognize that the overall objective of process control is of a long-term nature. However, for the time being on-line measurements can be introduced gradually to help operators adjust process streams to variations in feed.

4. Performance Evaluation

Most operators indicated that performance evaluation tests are not done frequently enough to meet the need to evaluate and optimize performance and overcome variations in feed characteristic. The reasons given are high costs and manpower requirements. The majority believe that CRL can play a role in conducting performance tests. There was a favorable response to the proposal of on-line tracers for performance evaluation of density separators. This work is of a short-term nature and can help diagnose problems, the resolution of which can lead to changes in the plant operating conditions which improve recovery. This improvement in plant recovery can be in the range of a 1 to 5%. Furthermore, collected

performance data from different plants can be a valuable tool for long-term R&D work in process development and for establishment of empirical simulation models.

5. Heavy Medium Optimization and Control

The heavy medium cyclone circuit is a standard process for the majority of Canadian preparation plants. It is usually the most efficient process, presenting few operating problems in the plant. However, changes in the size and feed ash can adversely affect performance. Magnetite losses are usually high and the change in magnetite size consist and magnetic characteristics can also influence heavy medium cyclone performance Several companies identified a need to improve heavy medium and operation control to optimize its performance. This work is mostly of a short-term nature.

6. Recovery of Coal from Tailings and Tailings Disposal

Large scale operations over the past 20 years have resulted in large tailings ponds at some mine sites. Some contain significant amounts of recoverable coal. Much of the coal lost to tailings is a result of losses in the fines cleaning circuits. Recovering coal from tailings can partly resolve the need for space for tailings disposal, and can reduce environmental risks while producing a saleable product. CRL has performed related work for a few companies in the past and can help in this area. The R&D work, which possibly requires size reduction for liberation, followed by deep cleaning, is supported by five companies and is of short-term duration.

7. Deep Cleaning and Coal-Liquid Mixtures

Deep cleaning refers to the reduction of ash and/or sulphur to below conventional levels or to the use of unconventional techniques (e.g. grinding) to liberate impurities. The interest in this subject is related to recovery of saleable coal from tailings material and to the upgrading of conventionally cleaned coal products. This interest is of

a longer term nature and is related to coal-liquid mixture applications and pipeline transportation. Coal companies are interested in research on this topic because it represents a possible alternative to conventional rail transportation.

8. Thermal Drying

Thermal drying represents a large part of coal preparation costs and as a result any improvement would reduce the total cost per tonne. Thermal dryer control in at least two plants appears to be a major concern. Automation of thermal drying would significantly improve performance.

9. Blending and Homogenization

Blending and homogenization are essential for consistent feed where coal is supplied from multi-seam mining operations. Unfortunately its use is limited in Canadian operations. The practice of blending before washing can significantly improve recovery in the preparation plant when dealing with highly variable feed. There is considerable interest in the subject. However, concern about the capital cost of installing blending facilities makes it difficult to implement. Studies that can demonstrate the benefits of homogeneous feed to preparation plants might help some companies decide in favour of installing blending facilities.

10. Process Development

Most of the interest in process development is related to the fines circuits as reported earlier, but some interest in the heavy medium process, Batac jig operation and control was also indicated.

11. Water Clarification

Concern about water clarification came from plants with significant clay problems. Two companies are actively seeking help in evaluating a new technology to improve settling of clays in thickeners.

12. Standards for Construction Materials for Preparation Plants

European coal industries have established materials standards for preparation plant construction and equipment. One company recommended that CRL, through a contract, should compile a Canadian manual for material construction and specifications based on experience gained in the last 20 years.

THE ROLE OF CRL IN SERVING INDUSTRY

The vast majority of companies contacted indicated genuine interest in what CRL can offer in specific areas. However, a few indicated that they prefer to deal internally with their own problems or at least with some of them. The following is a summary of how CRL can serve coal industry needs from the industry point of view:

1. Industry personnel want to be kept abreast of research in progress at CRL. This can be achieved through direct and continuous interaction with industry personnel by means of seminars at Devon and regular visits to mine sites by CRL staff.

2. CRL's coal preparation R&D program should be more relevant to operational problems, with the aim to improving both quality and recovery of saleable coal. This work should be a blend of fundamental and applied research to meet both short-and long-term objectives.

3. Industry recognizes the wide range of research needs and, due to limited resources, emphasizes the need to focus on high priorities (see R&D priorities). The majority of these priorities are of a short-term nature.

4. It is essential that CRL staff visit mine sites regularly (at least annually), so as to better understand operational problems and cooperate with company personnel to resolve them. Research work should be

oriented mostly towards operational problems. The overall objective is to improve recovery.

5. CRL with its unique facilities can help train industry staff. Secondment of industry personnel to CRL is a good idea, but is difficult to justify at present because of staff limitations at the mine sites.

6. It is essential that work carried out on behalf of industry be completed on time.

7. The Australian coal industry is viewed as being research oriented and could serve as a model for Canada. It emphasizes the importance of coal preparation in optimizing recovery. Companies employ highly trained researchers and have consortia or operating groups to interact and deal with specific problems. In that model CRL, could act as a catalyst for companies working together in developing novel solutions to common problems.

POTENTIAL FOR COOPERATIVE WORK

1. The timing for more collaborative research is good. This year the coal industry is experiencing a modest improvement in economic performance, following five years of cuts to all segments of its operations including coal research. Perhaps as significant are comments made by several managers on the need for operators to meet regularily with each other and with researchers to discuss common problems, new developments, etc. CRL/CANMET staff will take the initiative to organize such meetings, either in a revitalized Coal Preparation Society of Canada, or within the Coal Preparation Section of CIM's Coal Division.

2. Research needs vary from one company to another. However, fine coal circuit problems (water-only cyclone and froth flotation) along with plant performance evaluation to improve and optimize recovery are two areas that generated over 60% of the interest in cooperative work.

3. Four companies indicated a firm interest in working closely with CRL on research projects to improve operations. These companies represent up to 70% of the potential opportunities for cooperative work.

4. The proposed cooperative research involves both field work at preparation plants and work at the Devon facilities. Some projects would entail mainly field work. This would require flexibility and sufficient staff to handle both activities.

5. Some operators were skeptical or unsure about CRL's commitment to meet their needs for timely information. Special efforts are required to maintain credibility with such operators.

6. It is obvious from the above that the opportunities for cooperative work do exist. It is likewise obvious that those opportunities must be followed up promptly and developed into specific projects with commitments made on manpower and other resources so as to deliver results on time.

CONCLUSIONS AND RECOMMENDATIONS

1. There is general agreement between industry's research priorities and those of CRL. These priorities include fine coal treatment, transportation, process control and plant performance optimization.

2. There is a need for more communication and interaction between CRL and industry. This is no easy task. It requires researchers who are not only knowledgeable in their specialities but also capable of communicating effectively with operators at the mine site. Besides regular visits to preparation plants, seminars on topics of common interest related to new developments at CRL and elsewhere would be useful. It has been suggested by most that two seminars a year at Devon would meet that need. It was also suggested that a format similar to that used by former Coal Preparation Society of Canada is desirable.

3. The industry is interested in an R&D program geared to operational problems, to improve both quality and recovery. Most of these projects are of short to intermediate term (up to 2 years) with few defined as long-term.

4. Cooperative work with industry would include activities at the preparation plant site and in-house at Devon. Industry demands that committed work be completed on time; otherwise it is of little value to ongoing operations. Three specific proposals for cooperative work were made available and discussed with all companies. Most companies indicated an interest in participating.

5. Potential for cooperative research is good. Four companies are keen on starting cooperative work in the immediate to near future. Most of the work is related to fines treatment circuits and recovery optimization of plant operations in general. The timing is right to initiate such cooperative projects as the coal industry's attitude to research and market for coal are improving. However, extensive followup, with interested companies is necessary in order to define requirements of and formalize existing ideas into well-planned cooperative projects.

6. Industry interest in R&D work appears to be mostly of short-term duration and revolves around existing operational problems. This may not be the detriment of long term R&D, as might appear to be the case at first look. Experience gained from short-term projects will be instrumental in planning and executing future long-term R&D projects that could bring significant benefits to the coal industry.

Table 1 - Coal Industry R&D Priorities

Project	Interested Companies	Duration	
		Shorter Term	Longer Term
Fine coal cleaning & treatment	12	10	2
Transportation - Alter. (pipelining)	3	-	3
- Dustiness	6	6	-
- Freezing	2	2	-
Process Control - Automation	10	5	5
- On-line measurement	5	4	1
- Optimization	5	2	3
Performance evaluation to improve recovery	10	10	-
Heavy medium optimization & control	6	4	2
Recovery of coal from tailings and tailings disposal	5	5	-
Deep cleaning	3	-	3
Coal-liquid mixtures	3	1	2
Thermal drying problems	2	2	-
Blending & homogenization	2	-	2
Process development (may include fines cleaning)	4	2	2
Water clarification	2	-	2
Material construction and Specifications for prep. plants	1	-	1

APPENDIX A

LIST OF COMPANIES CONTACTED

LOCATION OF MEETING	COMPANY NAME	CONTACT(S)
Devon	Luscar Ltd.	David Adamson
Devon	Obed Mountain Coal	John Hinds, John Carsen
Hinton	Gregg River Coal	Boyde Payne, Richard Hobinski
Hinton	Cardinal River Coal	Mike Forbes, Harold Wirch
Grande Cache	Smoky River Coal	Edgar Horner, Rom Santos
Coal Valley	Luscar Sterco Ltd.	Bob Latimar, Morris Ennis
		Don Miller
Tumbler Ridge	Quintette Coal Ltd.	John Hogg
Tumbler Ridge	Bullmoose Operating Corp.	Wolf Nickel
Sparwood	Westar Mining, Elkview	Kevin Coombs, Fred Kovak
Green Hills	Westar Mining, Green Hills	Ernie Wittforth
Elkford	Fording Coal Ltd.	Heather Kennedy
Mine Site	Crows Nest Resources Ltd.	John Van der Broek
Sydney	Cape Breton Development Corp.	Bruce Clyburn, Jim Martin
Halifax	Nova Scotia Power Corp.	Dick Brown
Fredericton	New Brunswick Power Corp.	David Rankin

APPENDIX B

QUESTIONNAIRE

QUESTIONNAIRE - COAL PREAPRATION

Company Representatives

Location Date

1. Are you familiar with our pilot plant and related facilities? ... Y N

2. Would a one-day seminar or workshop to reviev CRL activities and capabilities in coal preparation be useful to you? ..... Y N

   If so, where should the seminar be held? (Devon, mine site, elsevhere)

3. Would you be interested in attending regular seminars on specific topics such as process control, devatering, fines cleaning, flotation etc.? ..... Y N

   If so, hov often?

   vhere?

4. What R & D work in coal preparation and transportation is needed to benefit the coal industry?

5. What short- and long-term achievements in R & D would gain a competitive edge for the Canadian coal industry?

6. How can CRL best serve your company's needs in improving quality and/or optimizing recovery?

7. Which circuits in your plant could benefit from cooperative work to optimize recovery and quality?

_____

_____

_____

_____

_____

_____

_____

8. Are performance evaluation tests done on these circuits? ..... Y N

If so, how often? _____

_____

_____

_____

9. Would you consider participating in the acquisition of on-line tracer systems for performance evaluation of density separators? Y N

_____

_____

_____

_____

_____

_____

10. Which circuit in your plant would benefit most from the implementation of in-line monitoring and/or process control?

_____

What parameters need to be monitored and/or controlled?

_____

_____

_____

_____

_____

_____

11. Available information indicates that flotation columns can improve the performance of flotation circuits. Would you consider pilot plant testing of your coals? .....Y N

_____

_____

_____

_____

_____

_____

12. We have prepared a proposal to evaluate an on-line slurry ash monitor in relation to a flotation circuit. Are you interested in participating in the proposed project? ..... Y N

_____

_____

_____

_____

13. How variable is your feed?

Would you consider blending? ..... Y N

14. We have developed a computer program for determining a strategy for the blending of different streams (raw coals, raw coals and clean coals, clean coals). Are you interested in seeing a demonstration on some of your coals? ..... Y N

Would you consider implementing such a blending program to optimize and improve recovery and quality in your operation? .... Y N

15. We have developed a computer coal program for manipulation of coal data (quality, size and float-sink), performance prediction and evaluation. Are you interested in seeing a demonstration of this program? ..... Y N

If the program appeared useful, would you consider using it in your operation? ..... Y N

16. Does the fines content in your run-of-mine change considerably? Y N

17. We have developed the ΔP technique to predict the amount of fines in the run-of-mine. Would you consider applying this technique to help predict the amount of fines from a particular mining area? ..... Y N

18. Which, if any, operations in your plant could be improved by the application of computer technology?

19. Are there any other specific areas of concern which require investigation?

_____

_____

_____

_____

GENERAL COMMENTS

APPENDIX C

PROPOSALS FOR COLLABORATIVE WORK

PROPOSAL
ON-LINE SLURRY-ASH MONITOR FOR FROTH FLOTATION CONTROL

BACKGROUND

Western Canadian coals are friable and as a result a high percentage of fines (-0.6mm) are generated during processing. The most effective circuits used in coal fines recovery are froth flotation, water-only cyclone and spiral. In Canada, the most commonly used circuit for fines recovery is flotation. Depending on various site-specific factors, losses of coal fines to tailings can range as high as 30% of recoverable coal.

Flotation might appear simple, however it is the most complex circuit in terms of the variables which can affect its performance. Some of these factors are coal rank, particle size, particle surface chemistry, bubble size, and hydrodynamic conditions in the cell which can affect the attachment/detachment mechanisms.

Field visits involving on-site discussions with plant operators were carried out in 1987, followed up by a vritten questionnaire focused on process monitoring and control. The objective of these CANMET initiatives was to:

- identify industry needs and problem areas
- provide input to CRL planning and strategy.

It was generally acknovledged that flotation is the most problematical circuit in terms of operation and control and can be improved by implementing process control. Moreover, the NMACC (Minister's National

Advisory Council to CANMET) recommendations indicated the importance of on-line (ash) monitoring for an effective and reliable control strategy for coal flotation.

CRL has since gathered technical and scientific information about the commercially available ash monitors and methods of their application. This information may be summarized under:

Principles of Measurement
- transmission
- backscatter

Measurement
- ash content
- ash analysis

Method of Application
- conveyor belt
- stream
- froth or slurry

The only commercially available monitor for froth product is the Australian Mineral Development Laboratories' (AMDL) Coal Slurry Analysis system (CSA). A set of 3 CSA probes is installed at each point in the feed or products of flotation. The 3 probes comprise:

i) **X-RAY FLUORESCENCE (XRF)** probe which provides a measurement of the ash and iron concentrations in the slurry.
ii) **DENSITY** probe which measures the slurry density (per cent solids by weight) and is affected by variations in the aeration of the slurry.
iii) **VOIDAGE** probe which measures the aeration of the slurry and corrects the density probe signal for the effects of aeration.

The probes are immersed in a tank through which the slurry stream flows. Three sets of probes are to be installed for (feed, froth and tailings) with one signal analyser, however this arrangement will be discussed further with the CSA manufacturer.

OBJECTIVES OF THE PROJECT

The objectives proposed are:

- in-house pilot-scale evaluation of the commercially available CSA AMDAL on-line slurry monitor.

- evaluation of the above monitor under field operating conditions.

- technology transfer to Canadian coal washing plants.

WORK PLAN

The proposed plan involves the purchase or lease of a slurry ash monitor for froth flotation process control. The commissioning and performance evaluation of the unit will take place in CRL pilot plant facilities at Devon, Alberta. The results will be reported to participating companies in: progress reports, discussions and meetings with operators. The results obtained and experience gained will be submitted in a final report and will be distributed to participating companies. The pilot plant performance evaluation of the unit will be directly succeeded by field performance evaluation. After completion of the field evaluation, the ash monitor will be reinstalled in CRL pilot plant for use in developing the froth flotation process control.

The anticipated capital cost is estimated to be $300-500K. It is proposed that this project will be a collaborative cost-sharing R&D program between CANMET, the participating companies and the Alberta Office of Coal Research and Technology (AOCRT).

PROPOSED TESTING AND EVALUATION TIME SCHEDULE

a) Reviev needs and define specifications: (2 months)
   - discuss plants' needs and requirements;
   - reviev flotation feed stream characteristics (such as size and ash range, and variation of ash content);
   - Finalize the testing schedule.

b) Lease or purchase of a CSA-AMDL slurry-ash monitor. (4 months)

c) Installation and commissioning of the monitor. (2 months)

d) Collection of data (measured and actual). (2 months)

e) Installation and field testing. (2 months)

f) Evaluation and economic assessment. (2 months)

g) Report vriting and preparation. (1 month)

h) Debriefing meeting with companies. (1 day)

A report will be prepared on the results, findings and experience gained. The report will be distributed to companies participating in the project.

Site-specific recommendations will be produced in a report and will be distributed to plants participating in the project.

BUDGET PROPOSAL

$300-350K

CANMET/AOCRT contributions would depend on the number of parties participating in the program and is negotiable. It is anticipated that each company will contribute $50K (potential of recovering 50% ($25K)) from the office of Coal Research and Technology, Fine Coal Program.

PROPOSAL

Evaluation of Column Flotation In Optimizing Recovery of Coal Flotation Circuits

INTRODUCTION

The amount of (-0.6mm) in run-of-mine Canadian coal ranges between 20 and 60% by mass. Yield losses in fine coal circuits average approximately 10 times those occurring in coarse coal circuits. Recent economic conditions have encouraged coal producers to reduce costs and thus search for means of improving the recovery of fine coal. The use of water-only cyclones and spirals has improved the recovery of the coarser fraction of fine coal (>0.15 mm). However, froth flotation circuits are responsible for considerable losses of fine coal. Optimization of flotation circuits can significantly improve fine coal recovery.

The CANMET Coal Research Laboratories have identified froth flotation as an area that requires intensive R&D effort. A pilot-scale flotation column (up to 2 tph) is being installed and will be tested starting January 1988. The following work statement presents a proposed program for cooperative work with industry to evaluate existing operations and the feasibility of using column flotation to improve fine coal recovery. The work plan can be modified to meet specific needs of individual companies.

OBJECTIVES

1. Evaluate the performance of flotation circuits in operating plants.
2. Compare the performance of conventional flotation and column flotation.
3. Identify means to optimize recovery of fine coal in the flotation circuit.

STATEMENT OF WORK

Phase I

Plant Flotation Evaluation

1. Carry out a sampling program to collect simultaneous samples of the feed, froth product and tailings over 3 to 8 h of normal plant operation, (company).

2. Ship samples to a private laboratory for analysis (per cent solids, ash, screen and float-sink analyses).

3. Collect a bulk sample of the feed to the flotation cell, devater and ship it to CRL, or if that is not feasible, send a rav coal sample (weight would depend on the proportion of the fines fed to froth flotation), (company).

4. Determine the performance parameters and efficiency of separation, (CRL).

Note: The company will supply CRL with information on plant flotation conditions, reagents used and reagent dosages.

Phase II

Pilot Plant Evaluation

1. Carry out screen analysis and float-sink analysis on two or three size-ranges of flotation feed, depending on the size distribution.

2. Perform preliminary bench-scale flotation tests to evaluate coal flotability using reagents supplied by the preparation plant, and test available reagents at CRL if necessary.

3. Perform a pilot plant flotation test by column flotation using plant reagents and dosages.

4. Perform a pilot plant flotation test using a conventional bank of flotation cells (Denver), and feed the tailings to the column flotation.

5. Collect incremental samples from the above tests for analysis and performance evaluation.

6. Compare results from bench, pilot plant and preparation plant, and identify relationships.

7. Determine differences in performance between conventional flotation and column flotation on a pilot scale, and potential for scale-up and compare with actual plant operation.

8. Make recommendations concerning the possible applications and potential benefits of column flotation.

Note: Company personnel may participate and/or observe the pilot-scale column flotation tests.

BUDGET ESTIMATE

Phase I

Company contribution to sampling program and shipment of bulk sample (estimated effort)	$10 000.00
CRL role in planning of plant sampling and evaluation of results	$ 5 000.00

Phase II

Bench-scale testing	$ 2 000.00
Washability and pilot plant tests, quality analyses	$ 3 000.00
Pilot plant tests	$12 000.00
Evaluation and reporting	$ 8 000.00
TOTAL	$40 000.00

The project will be cost-sharing between the interested company and CRL. The company will contribute $10 000.00 as effort (Phase I) and $20 000.00 in funds to CRL. CRL will contribute $10 000.00 in effort plus provide the necessary equipment for testing.

PROPOSAL

Performance Evaluation of Canadian Wash Plants

INTRODUCTION

A recent study in the USA has indicated that the clean coal recovery of many preparation plants can be increased by 2% simply by improving operating and maintenance procedures. Performance evaluation of density separators can determine the efficiency of actual operations and in turn lead to ways to improve and optimize recovery. Since more than 30 Mt of coal are processed annually in Canadian wash plants, an increase of 2% in recovery would yield an additional return of over $35 million per year. Regular collection of performance evaluation data and material balance would help operators to diagnose the causes of deviations from optimum performance.

Conventional methods for performance evaluation tests require collecting samples of the feed and products of the separator. Sample collection and subsequent float-sink analysis is labor-intensive and therefore costly, particularily for coarse particles (10 to 100mm). A newly developed tracer system to determine density separator performance eliminates the need for sampling and laboratory float-sink analysis by evaluating performance online. Consequently, the cost per test by tracers is reduced to approximately 20% of that by conventional procedures.

PRINCIPLE

Tracer particles that have been added to the feed are detected by the performance monitor in the products of the density separator. These tracers are composites of plastic and metal of various sizes and densities. Sensitive metal detectors, each of which consists of a transmitter, receiver antenna, and electronic control circuit, are mounted on the clean coal and refuse conveyors. The size- and density-dependent waveforms resulting from detected tracers are received in the control room and monitored by a chart recorder; the data are then processed by a microcomputer which produces partition curves and determines sharpness of separation as defined by probable error (Ep) and error area.

OBJECTIVES

1. Evaluate performance of density separators in terms of established standards.

2. Make recommendations to improve recovery after consultation with plant superintendents.

3. Promote independent performance evaluation in the plants by training industry personnel in the use of the tracer system.

4. Accumulate performance data for future R&D work in the optimization of various preparation processes.

STATEMENT OF WORK

1. The Coal Research Laboratory (CRL) will purchase the tracer system with funds supplied, in part, by interested companies.

2. Tracer detectors will be installed permanently in at least two locations (conveyors) in each contributing company's plant.

3. At two different times within three years of the purchase of the system, CRL staff will carry out performance tests for separators with particle sizes >5mm at each plant. Plant staff will have the opportunity to be trained during these tests.

4. Results will be reported only to the plant superintendent along with recommendations based on available data.

BUDGET ESTIMATE

<u>Capital</u>	
Tracer performance monitor	$55 000
Sensors	$ 5 000 per detector
<u>Operating</u>	
Tracer particles	$ 100 per test
Separator performance evaluation (2 CRL staff for 2 days)	$ 3 000 per test

The project will be cost-shared between interested companies and CRL. Each company's contribution will be $20 000, an amount which includes $10 000 for two permanently installed tracer detectors (if three are installed for three products separation add $5 000) and $10 000 towards the purchase (capital) of the system and performance of two tests at the plant. Additional tests will be charged at the standard rate. Other companies wishing to become involved in the project once it is underway will be charged at a higher rate, to be determined.